CHAPTER I

OPERATIONAL PROCEDURES

A. GENERAL

Services provided by the Joint Typhoon Warning Center (JTWC) include forecasts of tropical cyclone formation, intensification, direction of motion, speed of movement, wind intensity and changes in the size and intensity of the cyclone. The primary product of JTWC providing these services is the tropical cyclone warning issued in 1969 at 05Z, 11Z, 17Z and 23Z whenever tropical cyclones existed in the JTWC area.

FWC Guam provides computer and analysis support for JTWC.

Communications services for JTWC are provided by the Fleet Weather Central Nimitz Hill Division of Naval Communications Station, Guam.

B. ANALYSES AND DATA SOURCES

1. FWC ANALYSES:

a. Surface polar projection isobaric; 0000Z, 0600Z, 1200Z and 1800Z.

b. Surface mercator projection isobaric; 0600Z and 1800Z.

c. Surface micro-analysis of South China Sea region; 0000Z, 0600Z, 1200Z and 1800Z.

d. Sea surface temperature charts; daily.

e. Checkerboards (Stidd Diagrams) of selected tropical stations.

f. Time cross sections of selected tropical stations.

2. JTWC ANALYSES:

a. Sectional surface isobaric charts; hourly and 3 hourly as required.

b. Reconnaissance data.

c. 700 mb mercator projection contours; 0000Z and 1200Z.

d. 500 mb mercator projection contours; 0000Z and 1200Z.

e. 300 mb mercator projection contours; 0000Z and 1200Z.

f. Stidd diagrams of selected stations in the van of an approaching storm.

3. SATELLITE DATA:

The quality and quantity of satellite data available in 1969 was greater than ever before. ESSA 6 (later replaced by ESSA 8) and NIMBUS 3 provided local morning direct readout pictures. Nimbus 3 provided infrared direct readout pictures at night. Local afternoon ATS satellite pictures were available as a rectified digitized mosaic chart after an eight hour delay for processing.

4. RADAR:

Installation of weather radar at FWC Guam was completed in time for the 1969 typhoon season, but did not see much action.

5. COMPUTER PRODUCTS, 0000Z AND 1200Z:

a. Hemispheric analyses and barotropic prognoses for 1000 mb, 700 mb, 500 mb, 300 mb, and 200 mb.

b. Decomposition fields of the 500 mb (SD, SR and SL) analyses and prognoses. The SD, SR, and SL fields correspond to small scale disturbances, mean flow and long wave pattern respectively.

c. Computer analysis of tropical streamlines for the 700 mb, 500 mb, 400 mb, 300 mb, 250 mb, and 200 mb levels from FWC Pearl fields were used in 1969.

d. The HATRACK typhoon steering program based on SR prognostic fields was used on an operational time basis as a forecast aid.

e. The TYRACK typhoon steering program was operationally used during the 1969 season. This program utilizes the FWC Pearl tropical streamline fields for determining forecast movement.

f. Divergence charts based on FWC Pearl streamline fields were produced for evaluation beginning about 20 July. A preliminary report is included in Chapter III.

C. FORECAST AIDS

1. CLIMATOLOGY:

The following climatological publications were utilized:

a. Tropical Cyclones in the Western Pacific and China Sea Area (Royal Observatory, Hong Kong), covering 70 years of typhoon tracks.

b. Climatological Aid to Forecasting Typhoon Movement (1st Weather Wing).

c. Climatological 24-Hour Typhoon Movement (McCabe, J. T., 1961).

d. Western Pacific Typhoon Tracks, 1950-1959 (FWC/JTWC).

e. Far East Climate Atlas (First Weather Wing February 1963).

f. Annual Typhoon Report, 1968 (FWC/JTWC), covering tracks for 1959 - 1968.

2. PERSISTENCE:

Extrapolation of storm movement using average speed and mean direction was the most reliable method for 12 to 24 hour forecasts.

3. COMPUTER PRODUCTS:

a. The HATRACK typhoon steering program was run on the FWC Guam computer on an operational basis during 1969. Steering forecasts were made using the decomposition mean flow fields (SR) of the 700 mb, and 500 mb levels for prognostic fields through 72 hours. Empirical modification based on apparent error in earlier forecasts was used to obtain improved forecast positions.

b. TYRACK computer forecast steering from the 700 mb, 500 mb, 400 mb, 300 mb, mean 700/500 mb and mean 700/500/400/300 mb levels were used during 1969.

4. OBJECTIVE TECHNIQUES

During 1969 the following individual objective forecasting methods were employed:

a. ARAKAWA - surface pressure grid model.

b. HATRACK - based on 700 mb SR prognosis.

c. HATRACK - modified from 700 mb SR prognosis for 12 hour error. (for 24 hour forecasts)

d. HATRACK - modified from 700 mb SR prognosis for 24 hour error. (for 48 hour forecasts)

e. HATRACK - based on 500 mb SR prognosis.

f. TYRACK - based on program-selected best steering level from Pearl tropical fields.

Evaluation of these techniques is contained in Chapter III.

D. FORECASTING PROCEDURES:

An initial track based on climatology and extrapolation is developed for a 3 to 4 day period. The track is modified by considering the existing and forecast upper air patterns, numerical steering forecasts and the ARAKAWA objective method.

Subsequent forecasts become "educated" by longer period averaging of extrapolation error in speed and direction and through modification of computer forecasts to compensate for errors observed in earlier computer forecasts. A combination of extrapolation and climatology is the starting point for each forecast, with mesoscale analysis of the 700, 500 and 300 mb charts and the ARAKAWA objective forecast model used to modify or reinforce the extrapolation forecast. Position of tropical cyclones with respect to the 700 mb high center and ridge to the north and the 700 mb trough or break in the ridge to the west are the primary keys to 24 hour forecasting of recurvature or speed changes. The 200 mb level has been used to anticipate changes in intensity through assumptions of divergence in the southeast quadrant and convergence in the southwest quadrant of anticyclones. Tropical cyclones approaching a 200 mb anticyclone from the southeast are forecasted to intensify and those emerging from the west side of a 200 mb anticyclone are normally forecasted to weaken.

Extended range forecasting is based on extrapolation of the 24 hour track with reversion toward climatology and modified by SR and SL 500 mb forecast contours.

The resulting official forecast is an integration of both objective and subjective techniques with persistence in speed and direction the weighted favorite for short term forecasts.

E. WARNINGS:

Tropical cyclone warnings are numbered consecutively without regard for upgrading or downgrading of the storm between intensity stages. If warnings are discontinued and the storm again intensifies, warnings are numbered consecutively from the last warning issued. Amended or corrected warnings are given the same number as the warnings they modify. Forecast positions are issued as follows:

Tropical depressions	24 hr
Tropical storms	12, 24, and 48 hr (72 hr at 05Z and 17Z only)
Typhoons	12, 24, and 48 hr (72 hr at 05Z and 17Z only)

Forecast periods are stated with respect to warning time. Thus a 24 hour forecast verifies 26 hours after the aircraft fix data, 29 hours after the latest surface synoptic chart and 29 to 35 hours after the latest upper air charts.

Warning forecast positions are verified against the corresponding post analysis "best track" positions. A summary of results from 1969 is presented in Chapter III.

F. PROGNOSTIC REASONING MESSAGE:

Whenever warnings are being issued, an amplifying message is issued at 06Z and 18Z. This prognostic reasoning message is intended to provide meteorological units ashore and afloat with technical and non-technical reasoning appropriate to the behavior of current storms and the logic of the latest JTWC warnings.

G. TROPICAL WEATHER SUMMARY:

This message is issued daily from May through December and otherwise when significant tropical cyclogenesis is forecasted or observed. It is issued at 0600Z and combined with the prognostic reasoning message when warnings are being issued. It describes the location, intensity and likelihood of development of all tropical low pressure areas and significant cloud "blobs" detected by satellite.